Primary Production Algorithm Round-Robin 3 (PPARR3): Early results

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PRIMARY PRODUCTION ALGORITHM ROUND-ROBIN 3 (PPARR3)

Our goal is to provide a framework to systematically compare algorithms which estimate primary production from ocean color.

OUTLINE

Introduction

Approach

Results: global, basin, chlorophyll, SST

Conclusions and future work

RESULTS FROM PPARR2

PPARR2 was a blind intercomparison to *in situ* data. (89 stations worldwide PP: 0.88 - 2.3 g C m^{-2} d^{-1}).

Eight algorithms were within a factor of 2.4. If biases are eliminated, 10 of the 12 algorithms would be within a factor of 2.

Best performance in regions which have contributed historically more data. The Southern Ocean data presented worse results (dynamic range or light utilization).

The algorithms were highly correlated among themselves, irrespective of complexity.

PPARR3

PART 1. Annual cycle (1998). *Model output intercomparison.*

PART 2. Sensitivity analysis exploring biomass determination and parameterization of light utilization and photo-adaptive physiology. *Model intercomparison at different stages of PP estimation.*

PART 3. Comparison to in-situ ^{14}C-uptake (ClimPP: 1022 tropical Pacific stations). *Ground-truth comparison.*

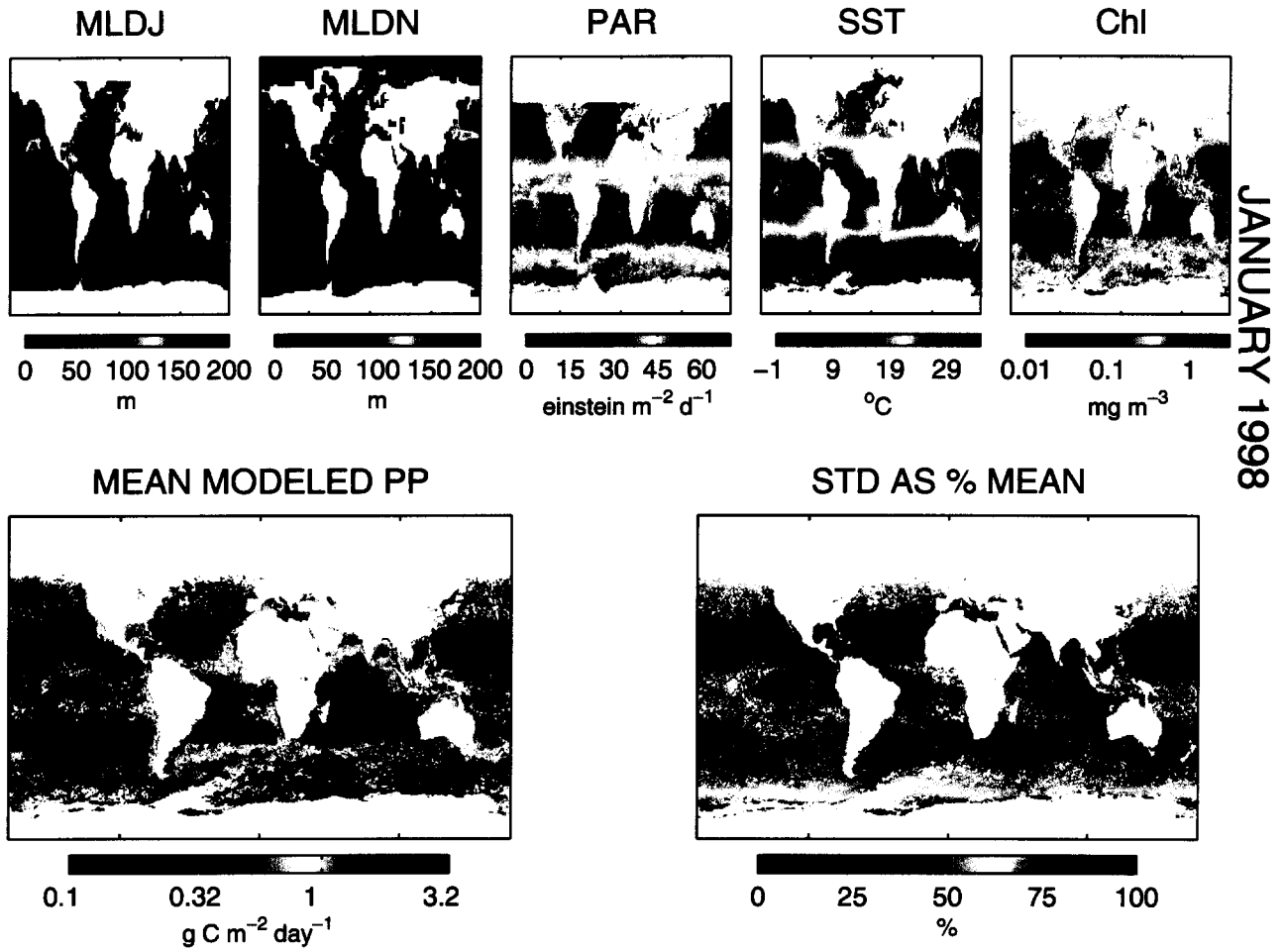
PARTICIPATING MODELS TO DATE

1'. David. IPCF. D. Antoine, B. Gentili and A. Morel.
2. Nick. BIO variant. N. Hoepffner and F. Melin.
3'. SteveA. Hybrid WIM. VGPM P_{Bopt}. S. Lohrenz.
4. SteveB. Hybrid WIM, IPCF P_{Bmax}. S. Lohrenz.
5. Kirk. K. Waters and B. Bidigare.
6. Mike. VGPM. M. Behrenfeld.
7. Mike2. VGPM (Eppley P_{Bopt}). M. Behrenfeld.
8. Aurea. VGPM. A. Ciotti.
9. Joji. J. Ishizaka and Mr. Kameda.
10. ModisBF. VGPM. K. Turpie and W. Esaias.
11. Heidi. Southern Ocean. H. Dierssen.
12. Heidi2. Southern Ocean chlorophyll. H. Dierssen.
13. Ichio. I. Asanuma.
14. Mark: Province-based. M. Dowell.
15'. ModisHYR. HoYoRy. K. Turpie and W. Esaias.
16'. RyYo. HoYoRy variant. J. Ryan.
17. HYRZe. HoYoRy variant (Z_e). M-E Carr.
18. John. J. Marra.
19. Michele. Neural network. M. Scardi.

APPROACH

Given identical input files (monthly mean)

Participants return integrated primary production.



Model spread quantified as a function of 'mean'

standard deviation of mean ($\overline{x}$) as percentage

$(x_i - \overline{x})/\overline{x}$, as percentage.

GLOBAL PRODUCTION

Mean global production for 1998 is 50 Gt C y^{-1}.

Standard deviation of the mean is 12.5 Gt C y^{-1} (25%)

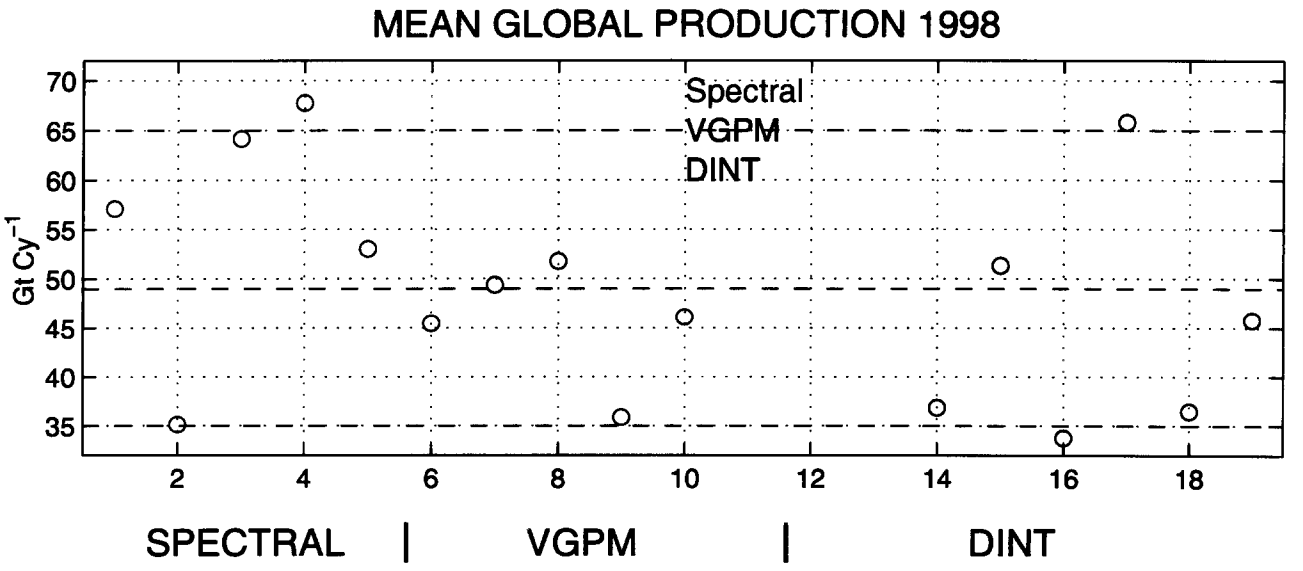
Range of model estimates is 40 Gt C y^{-1}.

LOW: ~35 Gt C y^{-1} (5 models)

HIGH: ~65 Gt C y^{-1} (3 models)

INTERMEDIATE: ~49 Gt C y^{-1} (7-8 models)

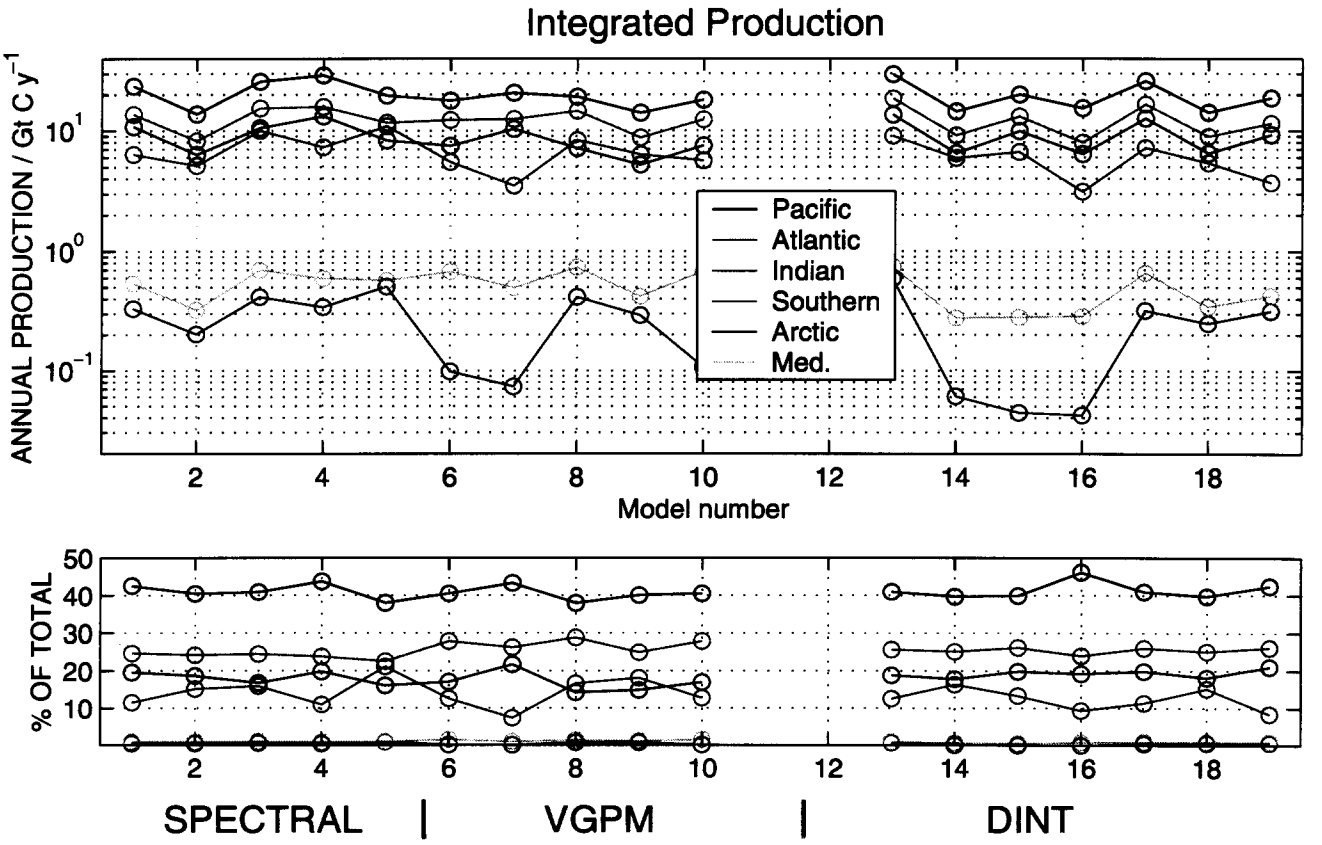
No VGPM variant is in the high level. A model of each kind is found in the low level.

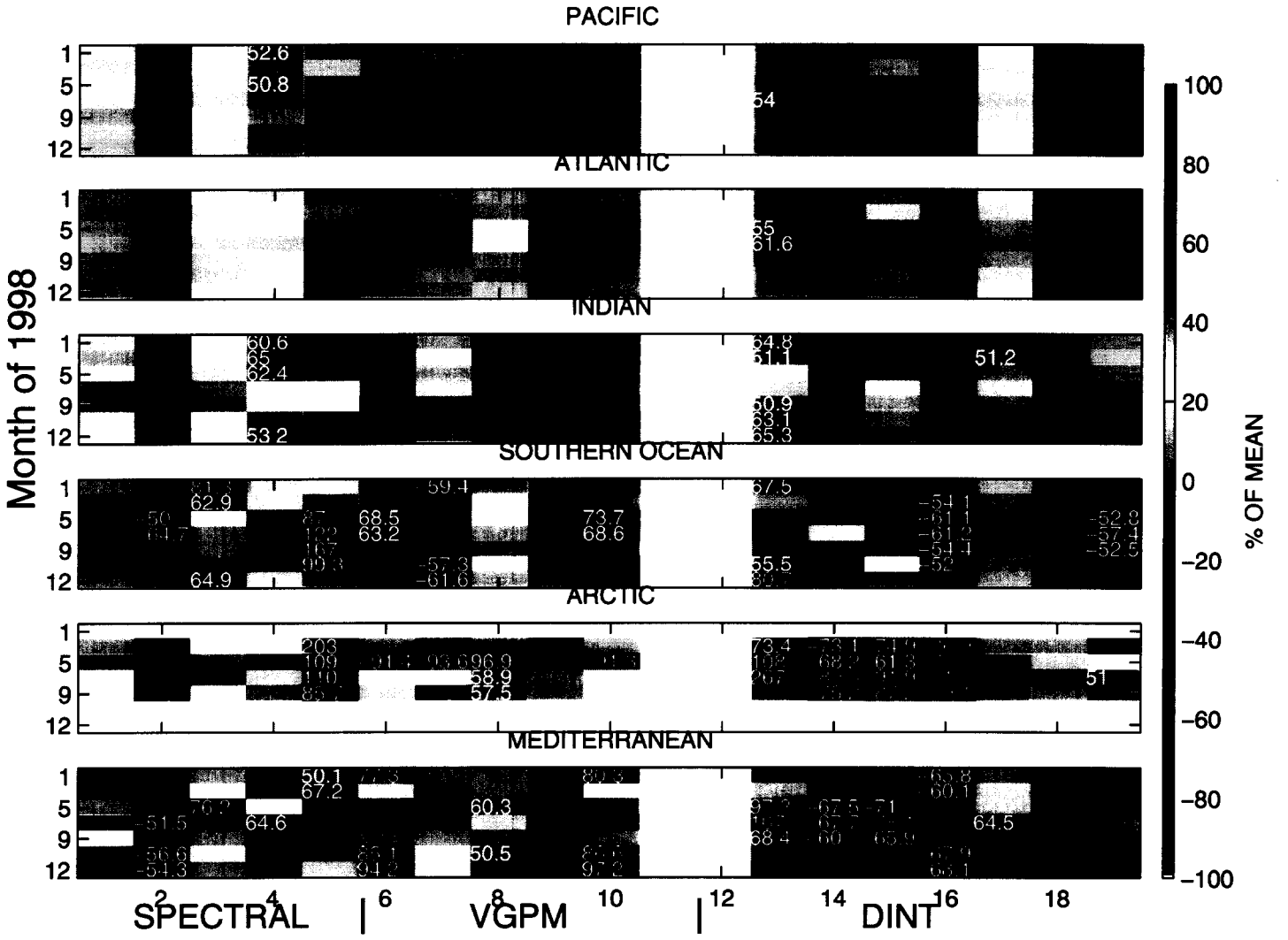


BREAKOUT BY BASINS

BASIN	AREA	MEAN (%)	MIN	MAX
	%	Gt C y^{-1}		
Pacific	42	20 (41)	14	30
Atlantic	21	12 (26)	8	18
Indian	14	9 (18)	5	14
Southern	22	6.5 (13)	3	11
Arctic	1.1	0.26 (0.5)	0.04	0.6
Med.	0.8	0.51 (1)	0.28	0.74

Variability in model estimates has maximum impact in the Southern Ocean, which has reduced PP in several depth-integrated models.





1-3 models diverge in the Pacific, Indian, Atlantic. (#4, 13, and 17 are high).

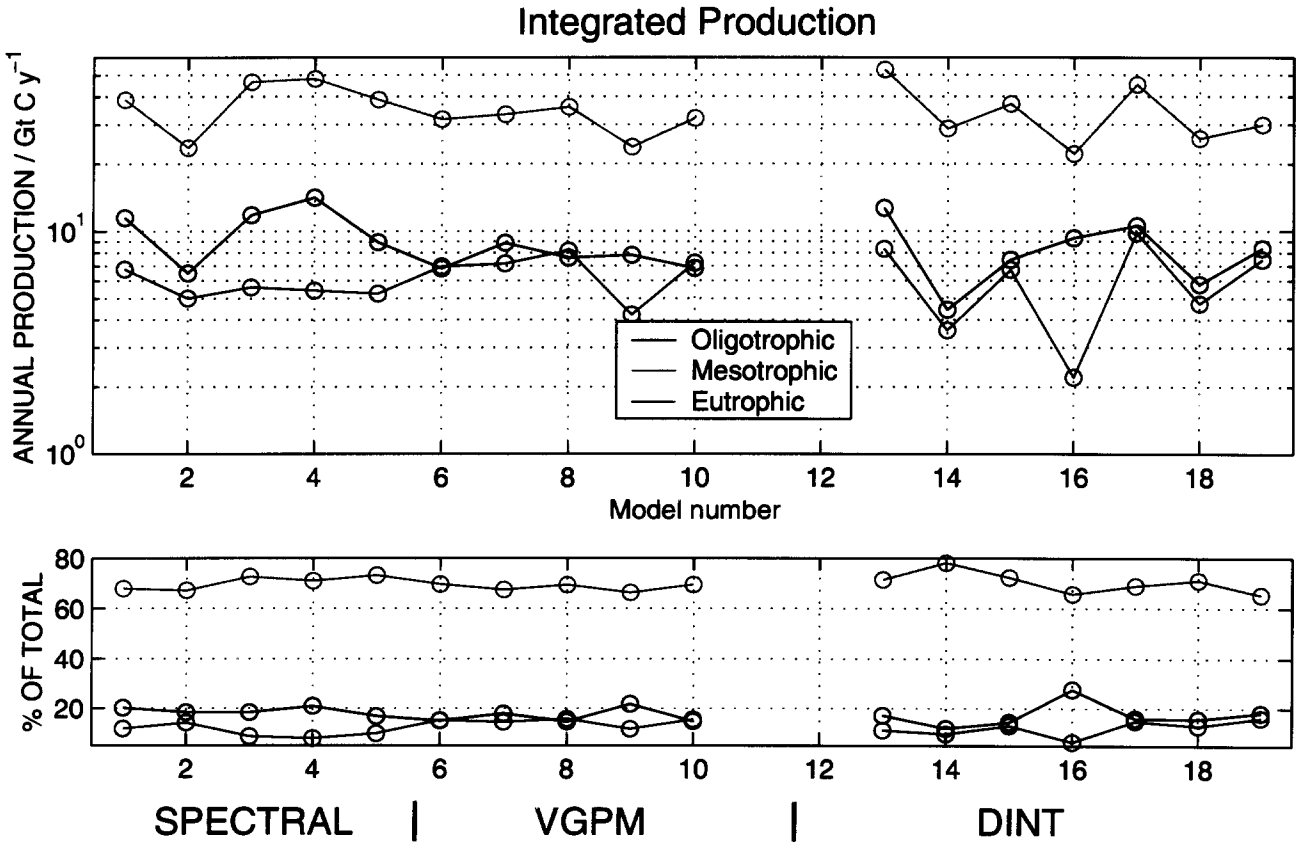
Nine 'anomalous' models (4 high/5 low) in the Southern Ocean. VGPM counter the seasonal cycle. #5 is high in cold waters.

~10 models are anomalous in the Arctic and Mediterranean (MLD HoYoRy and #14 underestimate).

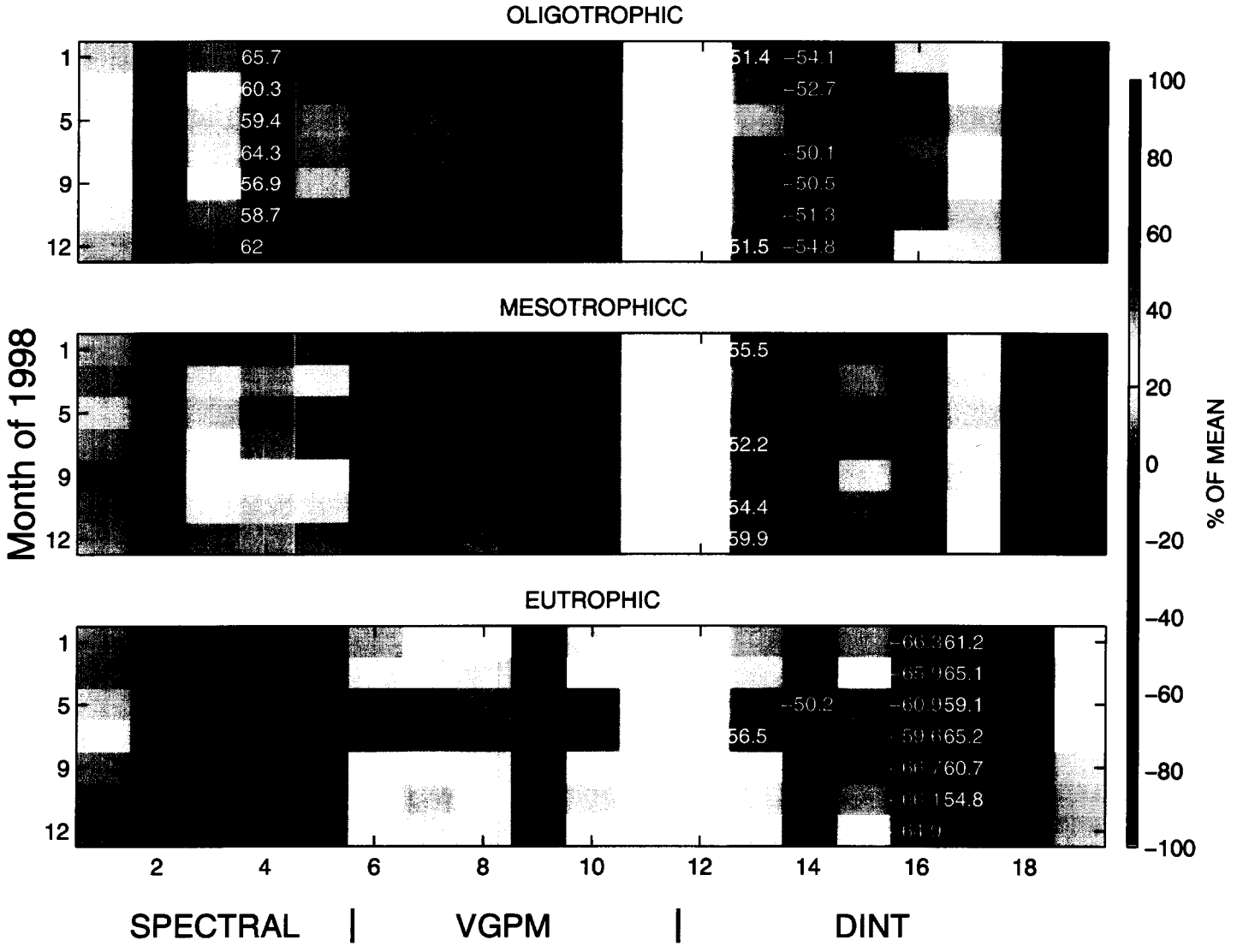
CONCENTRATION LEVEL

LEVEL	AREA	MEAN (%)	MIN	MAX
	%	Gt C y^{-1}		
Oligotrophic	~30	8.8 (18)	4.5	14.2
Mesotrophic	~65	35 (70)	22.2	52.9
Eutrophic	3-5	6.2 (12)	2.2	9.8

Models differ in the relative importance of eutrophic and oligotrophic waters.



#3-4 (high PP), and #16, #9 (low PP), produce more in oligotrophic waters than in eutrophic waters.



Only 1-3 models diverge significantly from the mean.

#4 /#14 consistently over-/under-estimate oligotrophic production.

#13 overestimates especially mesotrophic (unique).

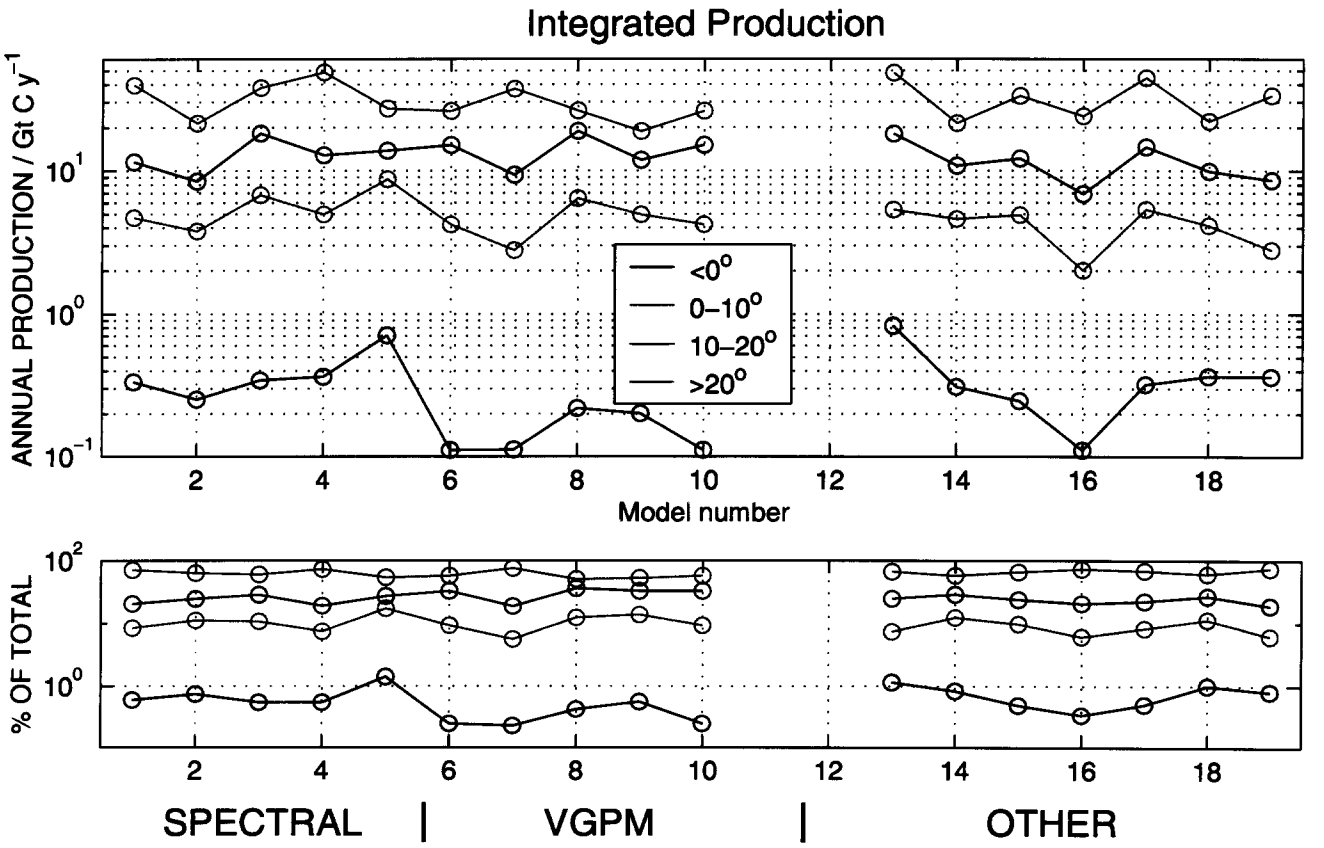
#16 /#17 under-/under-estimates consistently (both HoYoRy) eutrophic PP.

SST

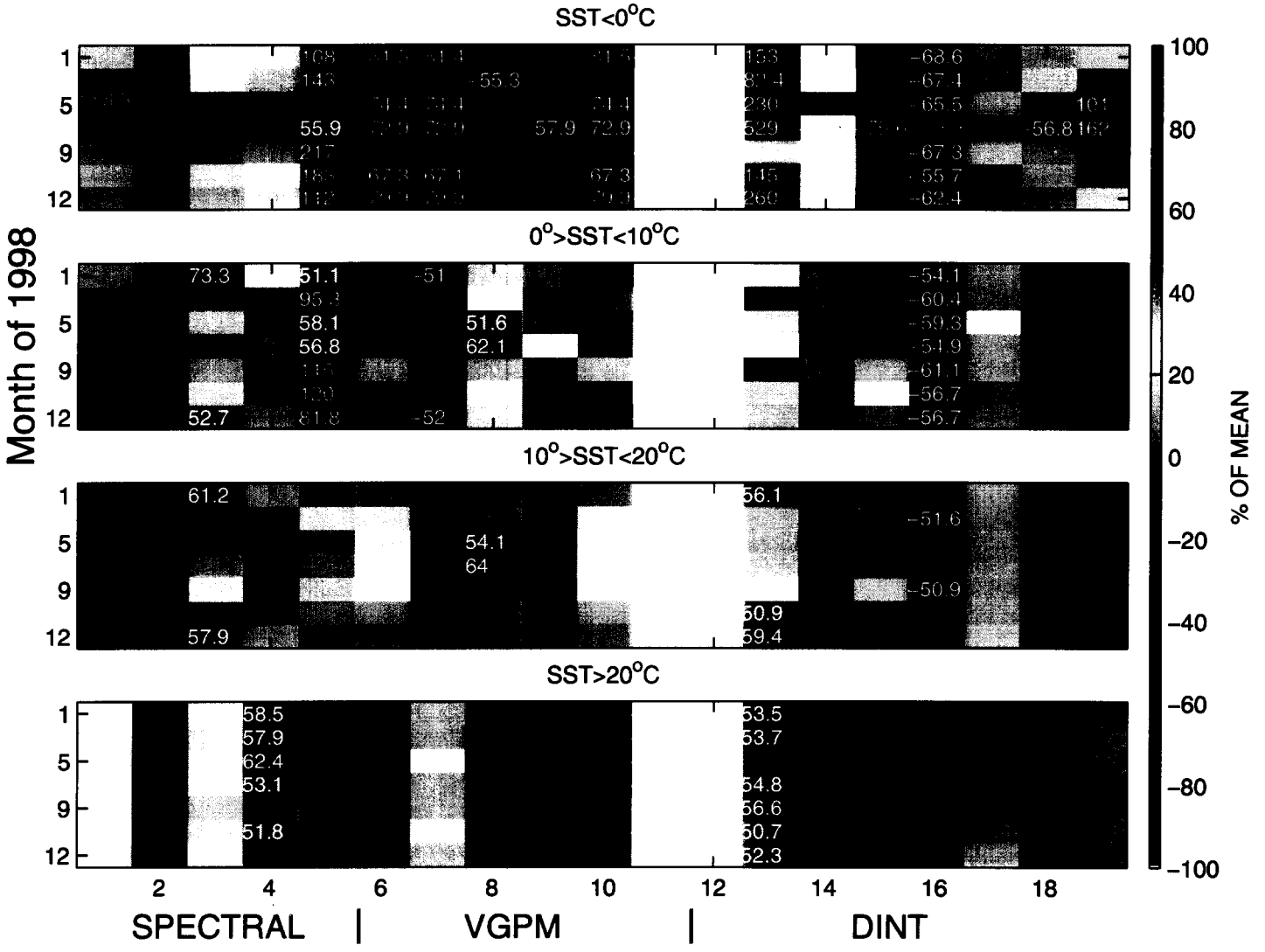
SST RANGE	AREA	MEAN (%)	MIN	MAX
	%	Gt C y^{-1}		
SST$< 0^oC$	2-4	0.31 (0.6)	0.1	0.8
$0^o - 10^oC$	13-17	4.7 (10)	2	8.7
$10^o - 20^oC$	~20	12.8 (26)	6.9	19
$> 20^oC$ SST	~60	31.4 (63)	19	48.5

PP in SST$<10°C$ is proportionately lower than area.

Models differ most $<0°C$. All VGPM and #16 / #5 and #13 have lower /higher PP.



#4 high PP in $> 20°C$.



Weak seasonal dependence.

Models differ most <0°C (two/four over-/under-estimate PP.

#5 /#16 over-/under-estimates PP <10°C year-round.

#4 overestimates > 20°C .

#13 generally overestimates at all SST values.

Outlier models

#16 (RyYo) underestimates in the Southern Ocean, Med, eutrophic waters and <10°C.

#5 (Kirk) overestimates <10°C, Southern Ocean and Arctic.

#6, 7, 10 (VGPM) underestimate <0 and counters the seasonal cycle in the Southern Ocean.

#14 (Mark) Underestimate < 0, and thus Southern Ocean and Arctic.

#17 (HYRZe) overestimates in eutrophic water.

#13 (Ichio) overestimates Indian, reinforces Southern Ocean seasonal cycle, <0°C and >20°C.

CONCLUSIONS

The spread between models is considerable (almost a factor of 2).

Greater disagreement for Southern Ocean, small basins, low SST (<10°C), and oligotrophic versus eutrophic waters.

Future work: Uncover the reasons behind these differences (Part 2) and comparison to *in-situ* data (Part 3).

Proposal to prepare *in situ* database for Southern Ocean for comprehensive model testing/parameterization.

Stay tuned...

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